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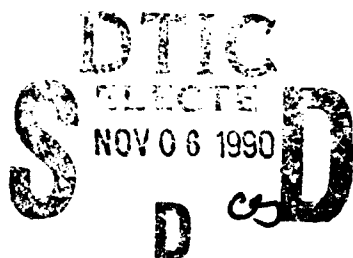
ARI Research Note 90-142

AD-A228 424

Interim Report: Developing Training and Systems Solutions for Combat-Critical Tasks

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Litton Computer Services



Field Unit at Fort Benning, Georgia
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September 1990



90

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United States Army
Research Institute for the Behavioral and Social Sciences

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REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188		
1a. REPORT SECURITY CLASSIFICATION Unclassified			1b. RESTRICTIVE MARKINGS ---			
2a. SECURITY CLASSIFICATION AUTHORITY ---			3. DISTRIBUTION / AVAILABILITY OF REPORT Approved for public release; distribution is unlimited.			
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE ---						
4. PERFORMING ORGANIZATION REPORT NUMBER(S) ---			5. MONITORING ORGANIZATION REPORT NUMBER(S) ARI Research Note 90-142			
6a. NAME OF PERFORMING ORGANIZATION Litton Computer Services		6b. OFFICE SYMBOL (If applicable) ---	7a. NAME OF MONITORING ORGANIZATION U.S. Army Research Institute Field Unit at Fort Benning			
6c. ADDRESS (City, State, and ZIP Code) 1300 Villa Street Mountain View, CA 94041			7b. ADDRESS (City, State, and ZIP Code) P.O. Box 2086 Fort Benning, GA 31905			
8a. NAME OF FUNDING / SPONSORING ORGANIZATION U.S. Army Research Institute for the Behavioral and Social Sciences		8b. OFFICE SYMBOL (If applicable) PERI-I	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER MDA903-88-C-0407			
8c. ADDRESS (City, State, and ZIP Code) 5001 Eisenhower Avenue Alexandria, VA 22333-5600			10. SOURCE OF FUNDING NUMBERS			
			PROGRAM ELEMENT NO. 63007A	PROJECT NO. 795	TASK NO. 3306	WORK UNIT ACCESSION NO. C3
11. TITLE (Include Security Classification) Interim Report: Developing Training and Systems Solutions for Combat-Critical Tasks						
12. PERSONAL AUTHOR(S) Osborne, Arthur D.; and Mullenix, Louise S.						
13a. TYPE OF REPORT Interim		13b. TIME COVERED FROM 88/01 TO 90/03		14. DATE OF REPORT (Year, Month, Day) 1990, September		
15. PAGE COUNT 18						
16. SUPPLEMENTARY NOTATION Contracting Officer's Representative, Seward Smith.						
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)			
FIELD	GROUP	SUB-GROUP	Light infantry, Land navigation, Weapon systems.			
05	06					
19	06					
19. ABSTRACT (Continue on reverse if necessary and identify by block number) This interim report summarizes the research support provided by Litton Computer Services to the U.S. Army Research Institute for the Behavioral and Social Sciences, Fort Benning Field Unit, Fort Benning, Georgia, during the period January 1988 through March 1990. The areas of research addressed were Training and Tactical Development for Light Infantry Readiness and Special Operations; Land Navigation Training and Positions Systems; and Weapon Systems Training, which included marksmanship instruction, MANPRINT, and marksmanship devices. The results of this research effort are contained in 45 reports and products.						
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION Unclassified			
22a. NAME OF RESPONSIBLE INDIVIDUAL Seward Smith			22b. TELEPHONE (Include Area Code) (404) 545-5589		22c. OFFICE SYMBOL PERI-LI	

U.S. ARMY RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES

**A Field Operating Agency Under the Jurisdiction
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Research accomplished under contract
for the Department of the Army

Litton Computer Services

Technical review by

Seward Smith



Approved: 	
NTIS: <input type="checkbox"/> DTIC: <input type="checkbox"/> Unpublished: <input type="checkbox"/> Justification: <input type="checkbox"/>	
By: _____	
Distribution: _____	
Approved: _____	
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INTERIM REPORT: DEVELOPING TRAINING AND SYSTEMS SOLUTIONS FOR COMBAT-CRITICAL TASKS

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**INTERIM REPORT: DEVELOPING TRAINING AND SYSTEMS SOLUTIONS
FOR COMBAT-CRITICAL TASKS**

This interim final contract report summarizes the research support provided by Litton Computer Services (Litton) to the U.S. Army Research Institute (ARI) for the Behavioral and Social Sciences, Fort Benning Field Unit, Fort Benning, Georgia, during the period 28 January 1988 through 30 March 1990 under contract MDA 903-88-C-0407.

During this 26-month period, the three areas of research addressed were TASK 01: Training and Tactical Doctrine Development for Light Infantry Readiness; TASK 02: Land Navigation Training; and TASK 03: Weapons Systems Training. Task 04: Bradley Fighting Vehicle Research was not funded during this period. This report covers all ARI funded research.

This is a five-year contract with a total value of \$8,723,791; however, ARI provided reduced funding for FY 88 and FY 89 (a total of \$3,198,400) and at the beginning of the second contract year, a decision was made to provide no ARI funding for FY 90 and beyond. ARI funding was expended on 30 March 1990. All contract tasks will remain in an open but unfunded state, in the event funding becomes available from sources other than ARI. All task work areas were closed out on 30 March 1990, except the Multipurpose Arcade Combat Simulator (MACS) effort which will continue with funding provided by Training and Doctrine Command (TRADOC).

TASK 01: Training and Tactical Doctrine Development for
Light Infantry Readiness

Task 01, Subtask 1: Identification of Training Shortcomings for
Light Infantry Readiness

Light Infantry

This effort was accomplished commensurate with the United States Army Infantry School (USAIS) analyses of the doctrinal, organizational, training, materiel, and leadership (DOTML) implications of placing the light infantry divisions into the force structure. Litton represented the only effort that addressed the full spectrum of DOTML research and provided validation from the field of shortcomings identified at the tactical and user-level units of the Army. This work is reflected in the subtask final report: Identification of Training Shortcomings in Light Infantry by Stanley E. Shaneyfelt and Gary G. Lambert.

Special Operations

Special forces leaders' guide. Litton produced a modular job performance aid information system for use by Special Forces (SF) leaders under field operational conditions. The objective was to provide individuals and units with common SF basic skill, intelligence, and operations task information in such a way that the requirement to transport large volumes of training and doctrine materials to the field would be alleviated. The product, Special Forces Leaders' Guide: Operational Detachment Personnel, is a compact, efficient manual in modular format which promotes fast information retrieval, can be personalized to meet individual or unit mission needs, and can be transported and used in adverse weather or low-light conditions. Bruce G. Shipley coordinated this effort from Fort Bragg, North Carolina.

Special forces reserve component training capability assessment. Litton investigated SF Reserve Components' capabilities in response to the 1st Special Operations Command's mission to assess training requirements and as part of ARI's light forces research program. The purpose of the assessment was to determine SF Reserve capability to train for more than one of the four SF missions: unconventional warfare, reconnaissance, direct action, and foreign international defense. Additionally, Litton investigated the value of maintaining SF specialty teams: high altitude low-opening (HALO) parachute operations and self-contained underwater breathing apparatus (SCUBA) proficiency. In this part of the assessment, Litton determined what training resources were required for total proficiency and at what unit-levels these teams should be maintained. The resulting working paper, An Assessment of Special Forces Reserve Component Training Capabilities by Bruce G. Shipley, et al., was submitted to ARI in 1988.

Task 01, Subtask 2: Review of Light Infantry Tactical Doctrine

Litton provided validation information from light infantry units on the effectiveness of doctrinal publications developed by the proponents. Substantial changes in training and operational literature resulted from these external findings. Additionally, a review of doctrinal literature was reported in Review of Light Infantry Tactical Doctrine by Gary G. Lambert.

Task 01, Subtask 3: Prioritize Research Issues

Litton provided USAIS the validated research issues that emerged from efforts with the 7th Infantry Division (Light). These issues became the focal point in the resolution of deficiencies ranging the spectrum of doctrine, organization, training, materiel, and equipment inherent to the light divisions. Shaneyfelt and Lambert provided several reports and briefings, culminating in Final Briefing and Report of Prioritized Research Issues.

Task 01, Subtask 4: Development of Research Solutions to
Light Infantry and Light Forces Training and
Tactical Doctrinal Issues

Lambert and Shaneyfelt prepared Research Plan for Development of Research Solutions to Light Infantry and Light Forces Issues and Briefing Materials to Include Text and Visuals. This five-year research plan provided the framework within which Litton and a large segment of USAIS focused on identifying and resolving training and doctrinal issues in light infantry units.

Infantry Training Automated Analysis System (ITAAS)

The information management system developed by Litton and described in the research plan has been adopted by a number of TRADOC analytical agencies and is used when resolving training and doctrine issues across all types of units and functions. The Infantry Training Automated Analysis System, ITAAS, developed by Gerald I. Dewey and Stanley E. Shaneyfelt, is a database management system designed to provide trainers and training analysts feedback from the results of external evaluations. ITAAS was devised in response to the leadership needs of the 7th Infantry Division (Light). No mechanism existed that enabled the senior trainers (leaders) of the division to capture and analyze training evaluation data at the individual, leader, and unit levels, and make analyses of systemic strengths and weaknesses. The ITAAS does that for the 7th Infantry Division (Light) and can be adapted to any unit within the U.S. Army.

TASK 02: Land Navigation Training

Task 02, Subtask 1: Development of Effective Method(s) for the
Training of Contour Interpretation

Cognitive Issues in Contour Interpretation was the result of literature reviews and consultations with experts in the cognitive field. In this report, Nancy N. Harris addressed key factors in the process of learning contour interpretation.

Task 02, Subtask 2: Development of Training Based Upon
a Cognitive Model for the Process of Position Location

Nancy N. Harris and Richard G. Moffett developed several interim documents, culminating in a report titled Dismounted Land Navigation Techniques. The product was designed to capture, in a "How To" form, the techniques identified in the Compendium of Expert Techniques.

Task 02, Subtask 3: Development of Training for
Mounted Navigation

Research on mounted navigation was not conducted during the initial two years of this contract.

Task 02, Subtask 4: Development of a Guide for Navigating
During Movement to Include a Codification of Specific Techniques
Used by Expert Military and Civilian Navigators

Two deliverables in the form of research notes were submitted to ARI in August 1989. Compendium of Techniques for Navigation During Movement was the result of extensive observations of expert navigators in the field and interviews with them. The note documents the techniques that experts use to navigate effectively in the field. Methods Used to Develop the Compendium of Techniques for Navigation During Movement followed, as author Richard G. Moffett documented methods used for the research in developing and compiling the Compendium.

Task 02, Subtask 5: Development of Exportable Training Which
Includes Basic Distance, Direction, and Location Skills

The Basic Skills Training Package, produced by Nancy N. Harris, incorporates all modules from the Basic Skills documents:

- (a) Basic Skills Training and Supporting Documentation -
Distance Modules submitted 18 November 1988,
- (b) Basic Skills Training and Supporting Documentation -
Direction Modules submitted 28 July 1989, and
- (c) Basic Skills Training and Supporting Documentation -
Location Modules, submitted 30 March 1990.

Each of the above reports consists of a discussion on how the basic skills (in distance, direction, or location) were identified and how they were reduced to training modules. Each report includes a discussion on the procedures used for the evaluation of the individual module. The three modules were designed to give specific guidance to trainers on how to train the basic skills of distance, direction, and location. Too, the modules can be used by individual soldiers to improve their own basic skills.

Task 02, Subtask 6: Development of Field Exercises Suitable for Institutional Training and/or Unit Settings Which Provide for Practice in the Systematic Integration of Land Navigation Enabling Skills

Mohammad Azhar-ul-Islam examined the issues that occur in the planning and execution of field training exercises for land navigation in Issues in Field Exercises Development. The report was delivered to ARI on 24 October 1988.

Mohammad Azhar-ul-Islam and Richard G. Moffett submitted to ARI on 30 March 1990 the Planning to Navigate product. In order to make the Planning to Navigate product more useful, a block of supporting stand-up instruction was developed and included as an Appendix. The instruction block was delivered to a unit of the 36th Engineer Group, and to the Resident Land Navigation Team of the 29th Infantry Regiment. The instruction was further tested using one platoon of Infantry Officer Basic Course (IOBC) students and later, Officer Candidate School (OCS) candidates. The evaluation included the formation and administration of a pre- and posttest, a field test, and a questionnaire. A videotape of the IOBC instruction was produced and will be used to supplement the Planning to Navigate product.

Triangulated Access to Coordinates at Extended Ranges (TRACER)

The efforts of ARI and Litton to provide a position location system (TRACER) that tracks soldiers during land navigation field exercises and delivers feedback about their performance were concluded during the contract period. Mary N. Perkins and James B. Thomas developed the documentation of the entire TRACER effort in a research note titled, Final Report on the Triangulated Access to Coordinates at Extended Ranges (TRACER) Project. Topics covered in this report are (a) the background justification for initiating the project, (b) a description of the system as originally planned, (c) a summary of research into alternative configurations, and (d) conclusions and recommendations for a final configuration.

During the contract period, accuracy tests performed on the original configuration, a very high frequency (VHF) system, showed VHF to be unsuitable due to erratic position location errors caused by vegetation and terrain-induced ground wave propagation anomalies. Alternative configurations, therefore, were investigated and subjected to accuracy tests. These alternatives included systems operating at low frequencies (LF, i.e., 100 kHz LORAN-C), medium frequencies (MF, i.e., 2 MHz ARGOTRAC), and ultra high frequencies (UHF, i.e., 1200 MHz, Global Positioning System, GPS). The LORAN-C investigation and the GPS data analysis were conducted by Eugene F. Greneker of the Georgia Tech Research Institute. Investigation of ARGOTRAC was conducted by the manufacturer of this system, Cubic Precision Survey System Division, Tullahoma, TN.

Conclusions regarding the best alternative configuration were based upon system accuracy, off-the-shelf availability, ease of acquisition by the Army, coverage area, and portability. Work conducted during the contract period supported GPS as the best candidate because (a) it will be in the Army system, (b) it can be used in any training area due to world-wide satellite coverage, (c) receivers can be made small and light-weight for unobtrusive use by infantry, and (d) it has operational as well as training capabilities.

Due to contract termination, experimental implementation of an alternative position location system for TRACER was not possible. Therefore, all TRACER equipment was returned to ARI and then transferred to the Army Corps of Engineers. Property transfer included removal of all field equipment (i.e., towers, instruments, fences, etc.).

Map Interpretation and Terrain Association Course (MITAC)

Litton continued MITAC-related work, coordinating training strategy with units and further developing resources in the field. Team members were actively engaged in testing or providing instructional support to USAIS, the 29th Infantry Regiment, the Army National Guard Mountain Warfare School, the Army Space Institute, and the National Training Center. And in a report describing his work in presenting Advanced MITAC to the 10th Mountain Division, Fort Drum, New York, Noel J. Hotchkiss submitted a report entitled Advanced MITAC Field Test.

Trainers' Guide to Land Navigation

Trainers' Guide to Land Navigation by Noel J. Hotchkiss, developed under contract MDA 903-84-C-0396, was revised and retitled Trainers' Reference Guide to Land Navigation.

TASK 03: Weapon Systems Training

Task 03, Subtask 1.1: Instructor Training Needs Assessment, Detailed Research Plan for Current Year and Outline Research Plan for Remainder of Contract Period

In an interim report, weapons team researchers Jamie W. Purvis, Ronald F. Martere, and Edward G. Sills describe the Development of a Needs Assessment for Effective Weapons Instruction. The preliminary needs assessment was conducted to identify areas of concern in instructor performance. Observations of instructor training courses and weapons instruction were conducted at Forts Benning, Knox, Dix, and Jackson, and at Aberdeen Proving Ground. Three areas of concern were identified: instructor selection and assignment, instructor certification, and instructor evaluation. These results were briefed

to the Commander, 29th Infantry Regiment, and his support was obtained for field experimentation at Fort Benning.

The Year Two Research Plan: Effects of Computerized Simulation with Two Levels of Augmented Feedback upon Acquisition of Marksmanship Skills by Jamie W. Purvis, Ronald F. Martere and Barbara A. Boyce, details a plan designed to determine the effectiveness of several training methods used to improve the marksmanship performance of one station unit training (OSUT) soldiers without a significant increase in time or resources, e. g., personnel or ammunition. A second purpose of the proposed research was to evaluate the effectiveness of drill sergeant performance during the downrange feedback period of basic rifle marksmanship (BRM) instruction. Drill sergeants play a major role in marksmanship training, primarily serving as coaches. A third purpose of the proposed research was to provide a basis for making recommendations for enhancing BRM instruction.

Task 03, Subtask 1.2: Annual Report of the Development and Evaluation of Approaches to Improving Instructor Training

The Development and Evaluation of Approaches to Improving Instructor Training by Purvis and Martere was delivered to ARI 20 January 1989. A needs assessment was completed to further clarify the nature of the areas of concern in instructor training in the weapons arena. Early data collection focused on observing weapons training at several different posts, providing the research team an opportunity to observe a variety of instructors at work under various conditions. Principally, however, instructor training and programs of weapons instruction were observed at Fort Benning, Georgia.

With Georgann Lucariello and Jean L. Dyer of ARI, Litton weapons team researcher Jamie W. Purvis authored Research Note Instructor Certification Materials and Observation Instruments for Dragon Weapon Training (1990). The report describes a comprehensive weapons instructor certification program, designed specifically for the Dragon, which will be used as a model by the 29th Infantry Regiment. The program includes training materials, tests, and instructor/student performance observation forms.

The primary training reference for all rifle marksmanship instructors in the Army is Field Manual 23-9, M16A1 and M16A2 Rifle Marksmanship. This manual was published July 1989. While not a formal part of this contract, the majority of the marksmanship training guidance presented in this manual was developed under a previous Litton contract, and during this contract considerable effort was devoted to revising draft versions of this document.

As the marksmanship research effort progressed and the general interest in the Multipurpose Arcade Combat Simulator (MACS) increased, it appeared that the greatest enhancement to overall marksmanship instructor quality would be through improved MACS programs.

Accordingly, part of the research goal of this subtask was accomplished through increased emphasis on subtask 3.3 (MACS).

Task 03, Subtask 2.1: Annual Report of MANPRINT Projects and Products

The classified research report, Integrating Stingray with Bradley Fighting Vehicle - Task Description and Prediction of Turret-Crew Workload, by Mike S. Perkins, identifies gunner and commander tasks created by integrating a combat protection system (Stingray) with the Bradley fighting vehicle (BFV) or its follow-on. A modified workload methodology developed by Anacapa Sciences, Inc., was used to predict visual, auditory, cognitive, manual and verbal workload imposed on the BFV gunner and commander by Stingray tasks, baseline BFV tasks, and the concurrent performance of Stingray and baseline tasks. Analysis of concurrent execution of baseline plus Stingray tasks was performed to identify when Stingray can and cannot be operated while performing other mission-related tasks. The workload analysis was used to develop the concept for an alternative interface design. The description of Stingray tasks and their sequence provides critical information for preparation of technical manuals and development of training. The alternative design concept provides a means to minimize workload imposed by Stingray while satisfying the required operational capabilities of the BFV. Identified conflicts and compatibilities among Stingray and baseline tasks predict when and how Stingray can be integrated with other task requirements of the crew. These predictions can be tested and evaluated during various phases of system development and can be used in the development, preparation, and refinement of "how to fight" field manuals.

Joel D. Schendel of HAY Systems, Inc., (under subcontract to Litton) authored technical report Lessons Learned from Analysis of the Improved TOW Vehicle with Implications for Future Systems. The report describes research involving the conduct of a partial Early Comparability Analysis (ECA) on the M901/M901A1 Improved TOW (Tube-launched, optically tracked, wire-guided missile) Vehicle (ITV) operator tasks. ECA is an important manpower and personnel integration (MANPRINT) front-end analytical methodology. Using a "lessons learned" approach, ECA focuses on individual soldier tasks and aims to identify problems in existing equipment and systems and to avoid them in related, future systems.

Research for this technical report grew out of an ECA which was performed by USAIS, Fort Benning, Georgia (USAIS, 1987). The results of the analysis appeared inconsistent with user-sponsor input and related test report data. One purpose of this research was to identify the source of the discrepancy between the ECA and other source data. The discrepancy appeared attributable to the fact that ECA addresses manpower, personnel, and training (MPT) issues. It does not provide for the direct assessment of human factors engineering, system safety, and health hazard concerns. A second purpose was to determine ways of enhancing the information generated from recommended ECA data sources. The research suggested several means for improving

the information gained from recommended ECA data sources without changing the basic methodology.

The research also identified significant problems affecting the ITV, most of which were documented in early operational test reports. Findings and recommendations related to the conduct of the ECA were presented to the proponent, U.S. Army Soldier Support Center - National Capital Region (SSC-NCR). Several of these recommendations have been adopted for use in ongoing analyses. Additionally, the report includes discussion of findings having general applicability for the design of armored combat vehicles. Recommendations developed from these data can be used to assist in the design of related, future systems.

Schendel, J. D., & Champion, D. F. (Research Note) Issues for the Acquisition of Mobile Battlefield Targets with Implications for Training. The research highlights issues and concerns related to target acquisition. Special attention is given to issues that carry important implications for the design of target acquisition training. The focus of the research is on the acquisition of armored combat vehicles such as tanks, but some observations apply as well to the acquisition of other types of targets. The paper includes consideration for problems affecting the use of direct-view optics for target acquisition, but primary emphasis is placed on the use of imaging infrared (IIR) systems. Target detection using IIR systems is seen as a primary example of a critical skill whose training has been neglected. The importance of this skill will only increase with advances in weapons technology. Developing suitable methods and materials for training target acquisition will require creative thinking and problem solving. Efforts should now be aimed at changing the focus of training toward target detection, toward the use of IIR systems, and toward the use of cues other than shape cues.

Task 03, Subtask 2.2: Annual Report of MANPRINT Lessons Learned

J. D. Schendel, K. M. Johnson, R. N. Riviello, of HAY Systems, Inc., in Manpower and Personnel Integration (MANPRINT): Some Preliminary Observations and Lessons Learned offer preliminary observations and lessons learned as a result of direct participation in and work accomplished under the MANPRINT program. The report provides an historical perspective on the continuing evolution of the MANPRINT program and outlines some considerations for improving the program in recognition of MANPRINT as an ongoing, iterative process.

Task 03, Subtask 3.2: Annual Report of the Development and Evaluation of Innovative Approaches in Weapon Systems Training

The Multipurpose Arcade Combat Simulator (MACS), patented in 1986, is a marksmanship trainer developed by ARI/Litton to supplement and enhance marksmanship training for soldiers. The basic rifle marksmanship (BRM) version of MACS enables soldiers to practice

shooting skills by firing at targets at scaled ranges displayed on the computer screen. Diagnostic feedback is provided on the screen. During this contract period the BRM program was greatly enhanced, resulting in more relevant performance measures, refined standards, more appropriate feedback, and automatic remedial procedures which moved toward the concept of a "teacher in a box." The system may be used for preparatory, basic, sustainment, and remedial training. Economically more feasible than other similar training devices, MACS is designed so that the basic hardware can be used also to provide training on a variety of weapon systems other than the rifle. Litton weapons researchers John M. Broom, David F. Champion, William H. Greene, Ronald F. Martere, and Jamie W. Purvis submitted Multipurpose Arcade Combat Simulator (MACS) Basic Rifle Marksmanship (BRM) to ARI in August 1989.

Litton developed a BRM program for MACS which is compatible with IBM/AT 286 (PC) microcomputer systems. The Commodore MACS/BRM program was rewritten for the PC as comparable as feasible. Modifications were made in the PC/DOS version to reflect upgrades in standards and measures, feedback and information screens, and optional features of the system. Authored by Alissa E. Harrison, Mark R. Newsome, and George E. Heshizer, Multipurpose Arcade Combat Simulator (MACS) Basic Rifle Marksmanship (BRM): PC/DOS Version specifies the standards inherent to this system and the instructional methodologies implemented in the system design.

Location of Miss and Hit (LOMAH)

LOMAH is a projectile location system which provides immediate feedback to the firer through a detection bar below the target area and a video monitor by the firing position. Precise feedback is provided for target hits and also for bullets which miss the target. This technology offers great promise for improved weapons training, training development and training of most shooting tasks. Litton maintained a LOMAH system on one of the Fort Benning ranges during this contract, but with the close-out of this research area, the LOMAH system was disassembled and turned in to ARI in March 1990.

Task 03, Subtask 3.3: Weapons Training Software

The Set Up Guide: Multipurpose Arcade Combat Simulator (M16) by Jamie W. Purvis and Ellen W. Wiley was submitted to ARI 3 February 1989. The report was subsequently revised and expanded into Trainer's Guide: Multipurpose Arcade Combat Simulator (M16) which was published as ARI Research Product 90-03.

The Trainer's Guide for the Commodore provides instructions for assembling system hardware, aligning the light pen mount, and troubleshooting. Detailed descriptions of the basic rifle marksmanship (BRM) software are provided, along with suggestions for training.

The MACS system hardware and the BRM software described in this report are being distributed by the Training Support Center at Fort Benning, Georgia.

Purvis, J. W., & Wiley, E. W. (1990). Trainer's Guide: PC Version of the Basic Rifle Marksmanship Program for the Multipurpose Arcade Combat Simulator (MACS). The PC version of the Multipurpose Arcade Combat Simulator (MACS) system was developed to explore the utility of existing IBM-AT compatible computers in the field as weapons training devices. Because it requires only the addition of a light pen board and an M16 replica rifle with a light pen attached to the barrel, the PC version of the MACS system is somewhat lower in cost than the Commodore system, although equally effective.

The Trainer's Guide for the PC version of BRM is intended to accompany each MACS PC version Assembly kit. The guide provides instructions for assembling the MACS system, using the menu, aligning the light pen, and an extensive description of the BRM program.

Purvis, J. W., & Wiley, E. W. (1990). Guia Del Instructor: Simulator de Combate de Proposito Multiple (MACS) (Fusil M16). The Trainer's Guide for the Commodore version of the basic rifle marksmanship program was translated into Spanish by Mercedes Miranda of the School of the Americas. The request for the translation originated at Training and Doctrine Command (TRADOC). The translation effort was coordinated by Kenneth L. Evans of Army Research Institute and Carlos Perrera of the School of the Americas.

Georgia Tech Research Institute (GTRI)

Given that ARI funding was not available beyond 30 March 1990 and that the resident Litton staff could not complete on-going MACS efforts, a subcontract was established with GTRI. Their statement of work identified the following hardware/software tasks for additional work:

- Finalization of existing BRM software for MS-DOS. This task consists of a review of the existing MS-DOS software implementing the BRM. GTRI was to validate the software, determine if there may be a better approach for some functions, recommend ways to optimize the source code and implement changes approved by Litton.
- Advanced rifle marksmanship program - moving target software. GTRI was to complete Litton's work on a moving target version of MACS for the Commodore and implement it functionally for MS-DOS.
- Light anti-tank training software. GTRI expanded a version of MACS software, previously developed by Litton, to provide training on the AT-4 Light Anti-tank Weapon. Originally it was

to be prepared for the Commodore and MS-DOS versions, but a decision was made later to limit the program to the Commodore due to the increased expense associated with integrating MS-DOS with a 27-inch television set.

- Trigger switch and light pen mount for actual M-16s. GTRI was to design and fabricate a trigger switch and mount that could be attached to existing M-16 weapons for training purposes. These devices are quick install, quick removal in order to allow Army personnel to outfit actual M-16s without extensive light pen alignment and with minimal supervision.

The aforementioned hardware and software products were delivered to Litton in various states of completion due to the limited time available. None of the products have been tested or validated for Army use. Further Litton work will focus on refinements and validation for the GTRI products. Also, the following two reports, the first of which represents joint effort between Litton and GTRI researcher M. Jackie McGill, are to be modified as appropriate.

- (1) Purvis, J. W., Wiley, E. W., & McGill, M. J. Trainer's guide: Multipurpose arcade combat simulator (MACS): Moving target training (M16 rifle).
- (2) Purvis, J. W. & Wiley, E. W. Trainer's guide: PC Version of the Moving Target Training Program for the Multipurpose arcade combat simulator (MACS).

Desktop Publishing

The addition of desktop publishing capabilities has enhanced the quality of products produced under this contract. This has been particularly evident in such products as the Multipurpose Arcade Combat Simulator (MACS) Trainer's Guide for the Commodore and the PC versions, the target screen graphics for the PC version of MACS, the Basic Skills training materials for land navigation, the Dismounted Land Navigation training materials, the figures for the Stingray report, and various briefing materials for all teams. By effecting technically superior publications through clear graphic representation, the dissemination of information gained through our research efforts has been advanced. Ellen W. Wiley's significant contribution within the life of this contract has made quality products and presentation materials a reality.

In Conclusion

Litton Computer Services under current contract #MDA 903-88-C-0407 to the Army Research Institute Fort Benning Field Unit has demonstrated consistently over the past two years the sound technical approaches necessary to key problem-solving and providing quality scientific support. In keeping with the tradition established at Fort

Benning in 1976, Litton's comprehensive research effort has produced timely, economical, and technically superior publications and products of the highest professional quality.

The mission of the ARI Field Unit, to assist in producing the best trained and equipped infantryman and thus ensure his survival and victory on the battlefield, has been our mission. Litton's total corporate experience encompassing behavioral, military, and scientific technical expertise; management and fiscal capabilities; quality control concepts; and vast resources have been embodied in a dedicated, mission-oriented staff on location.

Litton prioritized changing requirements and translated the ideas and innovations of active teamwork into performance and products. Research centering on light infantry readiness and special operations, land navigation training, and weapons systems training resulted in over forty deliverables in two years. With dispatch, Litton developed training strategy and systems solutions to the combat-critical tasks outlined in the statement of work.

The Multipurpose Arcade Combat Simulator (MACS) will be demonstrated at the Infantry Commanders' Conference in mid-april 1990 at USAIS: Thirty-five MACS kits, PC version, will be distributed to general officers to return to their units world-wide for preparatory, basic, sustainment, and remedial rifle marksmanship training. MACS has been fielded, in addition, to the joint services and the reserves through the Training Support Center at Fort Benning. Maintaining the hardware, updating the software, and generally keeping MACS operational in the field has occupied the time and resources of Litton personnel. The criticality of providing service support to users throughout the world makes imperative the continued development and funding of MACS. The potential of the MACS system to enable soldiers to improve their rifle skills and to develop confidence as marksmen has been validated. Developed by ARI/Litton and patented in 1986, the Multipurpose Arcade Combat Simulator has unlimited possibilities as a weapons trainer, and funding to keep the system alive and to extend MACS more fully to other weapon systems is considered to be mission-essential.

APPENDIX A

Reports and Products

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